

WO 00/47927

PCT/GB00/00430

19

BEST AVAILABLE COPY

1 CLAIMS:-

2

3 1. An apparatus for swaging an end of a tubular, the
4 apparatus comprising a swaging head for providing the
5 swage to the end of the tubular, wherein the swaging
6 head has two or more swaging formations provided
7 thereon to permit swaging of differing diameters of
8 tubular ends.

9

10 2. An apparatus according to claim 1, wherein the
11 swaging formation is provided on an internal bore of
12 the swaging head, such that the internal bore of the
13 swaging head is capable of engaging the outer diameter
14 of the tubular end to provide the swage thereto.

15

16 3. An apparatus according to claim 2, wherein each
17 swaging formation comprises a first diameter of the
18 swaging head, a second diameter being smaller than the
19 first diameter, a third diameter being smaller than the
20 second diameter, and a fourth diameter being smaller
21 than the third diameter.

22

23 4. An apparatus according to claim 3, wherein the
24 internal bore of the swaging head tapers substantially
25 linearly inwardly, with respect to the longitudinal
26 axis of the swaging head, from the first diameter to
27 the second diameter, and from the second diameter to
28 the third diameter.

29

30 5. An apparatus according to claim 4, wherein the
31 angle of the taper from the first to the second
32 diameter is greater than the angle of the taper from
33 the second to third diameter.

34

35 ~~6. An apparatus according to either of claims 4 or 5,~~
36 ~~wherein the surface of the internal bore of the swaging~~

Sub A2

WO 00/47927

PCT/GB00/00430

20

1 head provided by the taper from the first to the second
2 diameter is a guiding surface, and the surface provided
3 by the taper from the second to third diameter is a
4 swaging surface.

5
6 7. An apparatus according to any of claims 3 to 6,
7 wherein the surface of the internal bore of the swaging
8 head from the second/third diameter to the third/fourth
9 diameter is arranged to be substantially perpendicular
10 to the longitudinal axis of the swaging head.

11
12 8. An apparatus according to claim 7, wherein the
13 surface of the internal bore of the swaging head from
14 the second/third diameter is arranged to provide a
15 shoulder or a stop surface against which the tubular
16 end arrests, in use.

17
18 9. An apparatus according to any of claims 3 to 8,
19 wherein the swaging head is arranged with at least
20 first and second swaging formations, whereby the fourth
21 diameter of the first swaging formation is greater than
22 the first diameter of the second swaging formation.

23
24 10. An apparatus according to any of claims 3 to 9,
25 wherein the first diameter of the first swaging
26 formation is the closest diameter of all of the
27 diameters of all of the swaging formations to the
28 tubular end, in use.

29
30 11. An apparatus according to claim 1, wherein the
31 swaging formation is provided on an external diameter
32 of the swaging head, such that the external diameter of
33 the swaging head engages the inner diameter of the
34 tubular end to provide the swage thereto.

35
36 12. An apparatus according to claim 11, wherein each

SUB A3

WO 00/47927

PCT/GB00/00430

21

1 swaging formation comprises a first diameter of the
2 swaging head, a second diameter being greater than the
3 first diameter, a third diameter being greater than the
4 second diameter, and a fourth diameter being greater
5 than the third diameter.
6

7 13. An apparatus according to claim 12, wherein the
8 external diameter of the swaging head tapers
9 substantially linearly outwardly, with respect to the
10 longitudinal axis of the swaging head, from the first
11 diameter to the second diameter, and from the second
12 diameter to the third diameter.
13

14 14. An apparatus according to claim 13, wherein the
15 angle of the taper from the first to the second
16 diameter is greater than the angle of the taper from
17 the second to third diameter.
18

19 15. An apparatus according to either of claims 13 or
20 14, wherein the surface of the external diameter of the
21 swaging head provided by the taper from the first to
22 the second diameter is a guiding surface, and the
23 surface provided by the taper from the second to third
24 diameter is a swaging surface.
25

26 16. An apparatus according to any of claims 12 to 15,
27 wherein the surface of the external diameter of the
28 swaging head from the second/third diameter to the
29 third/fourth diameter is arranged to be substantially
30 perpendicular to the longitudinal axis of the swaging
31 head.
32

33 17. An apparatus according to claim 16, wherein the
34 surface of the external diameter of the swaging head
35 from the second/third diameter to the third/fourth
36 diameter is arranged to provide a shoulder or a stop

SUBA47

WO 00/47927

PCT/GB00/00430

22

1 surface against which the tubular end arrests, in use.

2

3 18. An apparatus according to any of claims 12 to 17,
4 wherein the swaging head is arranged with at least
5 first and second swaging formations, whereby the fourth
6 diameter of the first swaging formation is smaller than
7 the first diameter of the second swaging formation.

8

9 19. An apparatus according to any of claims 12 to 18,
10 wherein the first diameter of the first swaging
11 formation is the closest diameter of all of the
12 diameters of all of the swaging formations to the
13 tubular end, in use.

14

15 20. An apparatus for swaging an end of a tubular, the
16 apparatus comprising a swaging head for swaging the end
17 of the tubular, and a stop plate for abutment against
18 the other end of the tubular, the swaging head and the
19 stop plate being movably coupled to one another.

20

21 21. An apparatus according to claim 20, wherein
22 movement of the swaging head and the stop plate toward
23 one another facilitates swaging of the said one end of
24 the tubular.

25

26 22. An apparatus according to either of claims 20 or
27 21, wherein the swaging head is moveable toward the
28 stop plate by means of a piston.

29

30 23. An apparatus according to any of claims 20 to 22,
31 wherein the swaging head and the stop plate are movably
32 coupled to one another by a frame.

33

34 24. An apparatus according to claim 23, wherein the
35 frame is adjustable such that the distance between the
36 stop plate and the swaging head can be further varied

SUBA5

SUBA5

SUBA6

WO 00/47927

PCT/GB00/00430

23

1 \by means of adjustment of the frame.

2

25. An apparatus according to either of claims 23 or 24, wherein the frame comprises at least one member coupled to both of the swaging head and the stop plate.

6

26. An apparatus according to claim 25, wherein the coupling between the member and at least one of the stop plate and swaging head is capable of adjustment in order to vary the length of the member between the swaging head and the stop plate.

12

27. An apparatus according to either of claims 25 or 26, wherein the coupling between the member and the stop plate comprises a screw thread engagement.

16

28. An apparatus according to any of claims 20 to 27,
wherein the stop plate comprises a bore and a device
for obturating the bore, such that when the device
obturates the bore, the device abuts the said other end
of the tubular, in use.

22

23 29. An apparatus according to claim 28, wherein the
24 device is removable from the stop plate such that a
25 tubular to be swaged may be passed through the bore of
26 the stop plate.

27

30. An apparatus for swaging an end of a tubular, the apparatus comprising a swaging head for swaging the end of the tubular, and a clamping device for clamping the tubular, the clamping device being split into at least three part-circular clamping segments which clamp substantially around the outer circumference of a portion of the tubular to permit it to be swaged.

35

36 31. An apparatus according to claim 30, wherein there

WO 00/47927

PCT/GB00/00430

24

1 are at least four part-circular clamping segments which
2 clamp substantially around the outer circumference of
3 the tubular to permit it to be swaged.

4
5 32. An apparatus according to either of claims 30 or
6 31, wherein there are two clamping devices provided, a
7 forward clamping device which is arranged to be closest
8 to the swaging head, and a rear clamping device which
9 is arranged to be furthest from the swaging head.

10
11 33. An apparatus according to any of claims 30 to 32,
12 wherein the clamping segments are housed within a
13 clamping ring.

14
15 34. An apparatus according to claim 33, wherein the
16 clamping segments are mounted on the clamping ring in
17 an arrangement such that the segments can move with
18 respect to the ring.

19
20 35. An apparatus according to claim 34, wherein the
21 clamping segments can move only to a relatively small
22 degree with respect to the ring.

23
24 36. An apparatus according to any of claims 33 to 35,
25 wherein the clamping ring is split into at least two
26 part circular members.

27
28 37. An apparatus according to claim 36, wherein the
29 two part circular members are hinged together.

30
31 38. An apparatus according to claim 37, wherein the
32 two part circular members are hinged together such that
33 the ring is capable of being opened to permit a tubular
34 to be inserted into the ring, and closed to clamp the
35 segments around the tubular.

36

SUB A9

SUB A9

SUB A10

WO 00/47927

PCT/GB00/00430

25

1 39. An apparatus according to any of claims 33 to 38,
2 wherein a range of segments can be housed within the
3 ring.

40. An apparatus according to claim 39, wherein the range of segments is of varying radial thickness, to permit a range of differing diameter tubulars to be clamped.

41. An apparatus for swaging a tubular, the apparatus comprising a swaging head for swaging the end of the tubular, and a clamping device for clamping the tubular, the clamping device having a plurality of teeth for gripping the outer surface of the tubular, and a plurality of grooves formed between the teeth, wherein the gripping surface of each tooth is substantially parallel to the longitudinal axis of the tubular to be gripped.

42. An apparatus according to claim 41, wherein the
grooves are formed with two side walls which are
substantially perpendicular to the longitudinal axis of
the tubular to be gripped.

43. An apparatus according to claim 42, wherein the grooves are formed with a lowermost surface which is substantially parallel to the longitudinal axis of the tubular to be gripped.

44. A clamping device for use with the apparatus of claim 41, the clamping device comprising a plurality of teeth for gripping the outer surface of a tubular, and a plurality of grooves formed between the teeth; wherein the gripping surface of each tooth is substantially parallel to the longitudinal axis of the tubular to be gripped.